Argonne NATIONAL LABORATORY

Advanced Videoconferencing for Computational Fluid Dynamics (CFD) Training

Training Context	
Subject	Computational Fluid Dynamics (CFD) Training
Participants	• Argonne National Laboratory - TRACC (IL) • Turner-Fairbank Highway Research Center (VA) • University of Nebraska – Omaha (NE) • Illinois Institute of Technology (IL) • University of Illinois at Urbana-Champaign (IL) • University of Iowa (IA)
Training Method	Traditional lecture, hands on tutorial problems, and Q&A sessions
Length of Class	Three day class
Technical Context	
Conference Type	Multipoint
Technology Used	• H.323-based videoconferencing • Adobe Acrobat Connect
Additional Equipment	• Polycom HDX 8004 HD codecs • LifeSize HD Room System
Contact	
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Background

Argonne National Laboratory, in cooperation with the U. S. Department of Transportation (USDOT) Research and Innovative Technology Administration (RITA) has established the Transportation Research and Analysis Computing Center (TRACC), a state-of-the-art modeling, simulation and high performance computing center located at the DuPage National Technology Park in West Chicago, Illinois. TRACC uses Computational Fluid Dynamics (CFD) to improve analysis of the effects of wind and water forces on bridges and other hydraulic structures. TRACC uses commercial software, such as STAR-CD, on its massively parallel computer to create computer models of flowing fluids to describe and predict fluid response, such as the flow of air around a moving vehicle, or the flow of water and sediment in a river. Outreach is an important component of TRACCs mission, and thus this case study describes the use of videoconferencing to deliver one of TRACC's training programs to several remote sites.

Why videoconferencing was chosen

The need to train researchers in the use of the TRACC massively parallel computer to create and run simulations of computational fluid dynamics models required the delivery of high quality video, audio, and data to participants located at remote sites. Interaction between the presenters and the students in order to ask and answer questions is also required. Since the students will be required to create and run simulations, the need for students to display their computer desktop in order for the presenters to help debug problems is also required. Videoconferencing based on the standard H.323 videoconferencing protocol met these needs.

The Execution

The first offering of the Computational Fluid Dynamics (CFD) training course was conducted on April 27-29, 2009. CD-adapco, the vender of the STAR-CD software that TRACC uses for some of its CFD modeling, provided presentation material and user manuals to TRACC in electronic form as a basis for the course. Additional material was developed and added by the TRACC staff on the use of the TRACC cluster and tutorials related to hydraulics analysis. The course was given using H.323-based videoconferencing technology to create a virtual classroom with video and content sharing between three sites: the TRACC site located in West Chicago, Illinois; the Turner-Fairbank Highway Research Center in McLean, Virginia; and the University of Nebraska in Omaha, Nebraska. In addition, there were three sites where participants did not have access to videoconferencing equipment. The sites were the Illinois Institute of Technology, the University of Illinois at Urbana-Champaign and the University of Iowa. Participants at these sites were able to watch and listen to the course using Adobe Acrobat Connect running on a standard internet browser.

Large screens at each of the three main sites showed views of their classrooms and the technical course material. All three videoconferencing sites used end points capable of high definition video. The TRACC site was used as a presentation site where the instructors were located. The TRACC and Turner-Fairbank sites both used Polycom HDX 8004 high definition codecs as end points. The University of Nebraska used a LifeSize Room system high definition codec. The TRACC Polycom unit is capable of hosting three other remote end points in a multi-point conference and was used as the video bridge for the training class.

Argonne National Laboratory maintains a license to use the Adobe Acrobat Connect service. Remote sites can connect to a scheduled virtual room on the Acrobat Connect server located at an Adobe site using a standard internet browser. The presentation site similarly connects with only a browser plug-in required to share presentation material from the presenters computer to the other participants. The presenter's computer desktop was thus able to be shared with both remote sites using Acrobat Connect and with the H.323 videoconferencing sites by connection of the presentation computer to the videoconferencing codecs (uses the H.239 data sharing protocol supported by the videoconferencing units). Similarly, Camera video and audio from the presentation site was sent over the Acrobat Connect service to all of the remote sites using Acrobat Connect.

The combination of H.323 videoconferencing and Adobe Acrobat Connect provided the technology for group discussions of course material with the various remote sites. A highlight of the course was a set of hands on tutorial problems in which participants at all three sites used CAD geometry and STAR-CCM+ CFD software to, for example, build a bridge geometry, set up the physics for bridge flooding conditions, and run the CFD software to compute flood forces on the bridge under the guidance of TRACC instructors. When students ran into problems in a tutorial, they were able to transmit their laptop screen content to the other sites allowing instructors at TRACC to help them resolve problems. Participants at all sites were able to see and hear how problems were resolved. Course participants without H.323 videoconferencing technology at the Illinois Institute of Technology, the University of Illinois at Urbana-Champaign, and the University of Iowa were able to watch and listen to the course using Adobe Connect in an internet browser. Feedback on the course via a set of questions was requested and received from the majority of participants.

Evaluation comments

The instructors found the virtual classroom created with the advanced videoconferencing technology functioned very well. The views of the two other classrooms on the large screens were fairly close to actually having the class at a single location. The technology allowed the instructors to monitor the attendees

understanding of the lecture and pick up the pace or wrap up a session, as needed. This type of adjustment based on watching reactions of the class while speaking is not possible through most other internet training formats. One concern before the course was that not having a CFD expert at the remote sites would make problems encountered by students participating in the tutorials difficult to resolve. When CD-adapco runs CFD courses, there are usually two instructors, and while one leads everyone through a tutorial with students working it out on their own computers, the other instructor will move around the room helping people who get stuck. As noted under the Execution Section, when students at remote sites run into problems during tutorials, they were resolved by using the content sharing technology, which had the added benefit of allowing everyone to see how problems are resolved in several different instances.

The biggest technical problem faced by the instructors in preparing for the course was resolving issues related to installing trial licenses for the software on participant laptop computers to enable them to participate in doing the tutorials. This difficulty is primarily a consequence of the complexity of the license server software. One student at the Turner-Fairbank facility was talked through the license installation procedure using the videoconferencing facilities during a test of the videoconferencing. One student at the University of Nebraska was talked through the license installation procedure via a long phone call. These students then helped the other course participants install the CFD software and license software and on their computers. Options for making this process easier are being evaluated for the next course.

A feedback questionnaire was returned by 12 of the participants in the training. All of the responding participants felt that the virtual classroom worked very well. Most would like to participate in additional courses on other CFD software and related software. All felt that the tutorials played a very important role in the learning experience. Actually working through several problems on a computer with instructor guidance provided valuable hands on experience. The participants using Adobe Connect also wanted to be able to work through the tutorial problems during the course.

A major advantage of using the videoconferencing for CFD training appears to be that a training class can be composed of several small groups of participants at different locations, when participants in the small groups cannot afford to travel to a central location for a course and when instructors cannot afford to travel to a distant location to provide training for a group of less than ten participants. Thus the videoconferencing option allows knowledge of how to use CFD tools to be disseminated via training in virtual classes much more rapidly than when it is restricted to face to face classes with ten or more people.

The Barriers

The only barrier noted was that not all sites had access to H.323 videoconferencing end points. Although they were able to successfully participate in the training class, they did not enjoy the highest level of videoconferencing in the form of resolution of displays and interactivity that the three H.323 sites were able to receive.

Although it was not a problem for this relatively small training class, the Polycom HDX 8004 codec has a maximum capacity to bridge four end points (including Polycom HDX). Larger numbers of remote H.323 sites would require a larger bridge or a Multipoint Control Unit (MCU).

The Enablers

Each of the three videoconferencing sites had good connectivity to various research and educations networks with Internet2 providing the interconnecting backbone. Each site was able to connect at 1920 kbps thus providing good quality video. Each site had a modern codec (either Polycom HDX 8004 or LifeSize room systems) that made high quality audio and video and H.239 data sharing possible.

The three sites without H.323 equipment availability were able to take advantage of the interoperability between H.323 videoconferencing and Adobe Acrobat Connect that TRACC provided.

It should also be mentioned that an important aspect to a good videoconference is testing the equipment well before the scheduled event. All sites were ready and eager to participate in this testing.

Advice for new users

Videoconferencing encourages collaboration and sharing of information between participants. This tool is also useful for technology transfer through classes and training. Good technical support is essential for a successful event; technical support will provide the appropriate technology for the information you plan to present and will test connectivity with all participating sites.

It is best when speakers are briefed in advance regarding the nature of videoconferencing and what to expect. The information presented should be clear and be able to be seen at all remote sites. Make sure that discussions can be clearly heard by participants at all sites.